

# Construction Research Funding

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Learning to contribute to the body of knowledge through research is a function of an effective graduate program. A research agenda, and especially an externally funded research agenda, is a university requirement for many Construction Management (CM) faculty. New faculty, especially those in transition from industry to academia, are faced with a myriad of unfamiliar requirements. With few historical examples, and often little guidance to follow in the process of creating a funded research agenda, it is difficult to meet expectations. Government funding through sources such as DOT, DOE, HUD, NSF are available to construction management faculty who are able to negotiate the daunting process of application. National, regional and local construction organizations are also groups to consider when searching for funding. Due to the breadth of the construction industry, it is helpful to create a focal point of research for individual faculty members in order to achieve successful funding of a research agenda.

**Key Words:** Construction, Research, Funding, university faculty

## Introduction

This author has been challenged in his current doctoral program to learn appropriate methodologies for both quantitative and qualitative research. Conducting research is not only a requirement of the author's doctoral program, but will also be the primary basis for defense of the upcoming dissertation. Research, and especially funded research, is included in the professional development plans at many universities, including the author's current place of employment. Twenty percent of an assistant professor's time is expected to be allocated to research at MN State University Mankato (MSU). External funding of research is a basis for tenure and promotion at MSU, as it is for many institutions.

The purpose of this review of research was to orient myself and other new faculty to funded research opportunities that would serve both personal and professional development. It is this author's hope that the work might shed some light on a challenge faced by faculty who are in transition between industry and academia and are just beginning to explore a research agenda.

## Literature Review

Coordinating a research agenda for graduate students is a challenge to doctoral level programs. Haksever (2000) surveyed 149 Engineering PhD students in the UK. The survey assessed the supervision within the program. He divided supervision of PhD candidates into three elements, personal, indirect research-related and direct research-related. Haksever received 57 responses to his survey. In analyzing the results, respondents stated that the gap between actual supervision and needed supervision in the areas of personal and indirect research-related help was significant, but not "dangerously big." However, the highest need for supervision and the lowest provided supervision was in the direct research-related category. Several of the study groups showed that 23% of the PhD students lacked the supervision needed in order to accomplish the research necessary to complete the degree (Haksever & Manisali, 2000).

The Building Research Board (1994), divided infrastructure research into seven niche opportunities (Gould & Lemer, 1994). The research areas, summarized in Table 1, are specific to infrastructure development, but also have a broad application to the construction management profession.

**Table 1**

*Infrastructure research niches with sample research topics (Gould & Lemer, 1994)*

1) Systems life-cycle management	Issues of demand, prices and costs
2) Analysis and decision tools	Assessing consequences of materials innovation Emergency procedures Demand/capacity analysis
3) Information management	Remote satellite imagery Supervisory control and data acquisition
4) Condition assessment and monitoring technology	Management of waste and residuals Site characterization
5) Science of materials performance and deterioration	High performance materials applications Time-dependent deformation and strength
6) Construction equipment and procedures	Improved information exchange Automated tunneling
7) Technology management	Technology compatibility assessment Impact of procurement methods

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The topics, common to most niches of construction, begin to categorize research in a way that connects the estimating, scheduling, project management, equipment management, technology and materials that are part of the construction management curriculum.

Chinowsky and Diekmann (2004) studied construction research heritage, finding 3000 papers published between 1962 and 2002. The research was divided into seven general areas with 25 research topics. Appendix A lists the research areas and topics, along with the percentage of papers that belong to each area. The most common topic of research is technology, with 30% of all papers on the topic. Also high on the list are project execution and project planning, each with at least 20% of the papers. Of some note are the two least often published categories, education (only 7%) and materials (2%). Conclusions of the study showed research output during the 2001-2002 year to be down by 35% from the peak output years of 1993-1994. The study also indicated that there was a lack of stability in the research focus, where research has moved into and out of various research topics. The third conclusion was that there was a lack of collaboration within the construction community, with most papers emphasizing individual efforts on the spectrum of research topics. The Chinowsky and Diekmann report indicates a need for construction management education and materials testing rather than the technology arena, which, at the time, seemed to be most popular. The research is currently dated, due to the explosion of sustainability and BIM research. However, the conclusion that research has blown in the wind of popularity is certainly justified.

Puddicombe (2006) separated construction knowledge creation into two segments. The first is the knowledge of a particular project, which is exercised in the planning process. The second is the knowledge of the interrelationships within the project team and the impact of those relationships on the project. Puddicombe (2006) commented that there is a “relative paucity” of research on how to facilitate the creation of knowledge in construction management. Citing the work of Chinowsky and Diekmann (2004), he stated that collaborative process of knowledge creation was a particularly appropriate area of research (Puddicombe, 2006).

The literature on the topic of construction management research is limited in both scope and volume. There were few studies on the topic and no articles available through the International Journal of Construction Education and Research. The topic of graduate school has been reviewed by the Associated Schools of Construction Doctoral Education Task Force (ASC, 2005). The task force was created due to the expressed need for more graduate programs in order to produce more instructors for undergraduate education. Research was not addressed by the task force.

## **Government Funding Sources**

### *National Science Foundation (NSF)*

The National Science Foundation (NSF) was created in 1950 in order to “promote the progress of science; to advance the national health, prosperity and welfare; to secure the national defense.” The FY 2009 budget for NSF is 6.8 billion dollars, accounting for 20% of all federal research dollars at American colleges and universities (National Science Foundation, 2008).

NSF funds research and education in 2000 colleges in the United States. Approximately 40,000 proposals are received each year and approximately 11,000 are funded (National Science Foundation, 2008). Proposal submission deadlines are continuous, with approximately 60 deadlines for the month of February 2009. NSF uses a “bottom up” method, where funding opportunities are published (solicitations) by NSF and individual researchers submit proposals which describe their ideas on how to meet the particular solicitation needs. Proposals are subjected to a process of merit review (National Science Foundation, 2008).

NSF has divided their funding opportunities into 12 program areas, with several additional special programs. Funding opportunities may be found on a user friendly web site ([www.nsf.gov](http://www.nsf.gov)). A search of federal funding from the National Science Foundation (NSF) using “construction funding” as the key word found over 11,000 documents. The best opportunities through NSF appear to be in the post secondary education and sustainability. There are numerous opportunities for innovative teaching in post secondary education and there are multiple proposal deadlines for sustainability on each month (National Science Foundation, 2008).

The information from NSF is easily obtained, but is massive in quantity and takes a substantial time commitment to review. Proposals are extensive and will also take a substantial time commitment to complete. However, the grant awards from NSF are typically between \$100,000 and \$500,000.

Some of the grant funds are available by working with secondary funding sources. Universities receive grant money with the stipulation that they collaborate with other institutions on the project. Secondary source funds are received by applying directly to the funded university and not through NSF (National Science Foundation, 2008).

### *Housing and Urban Development (HUD)*

The Housing and Urban Development (HUD) web site revealed 3,360 items on a search using “construction research” as the key word. HUD has an office of University Partnerships (OUP) and also a public-private partnership called PATH (Partnership for Advancing Technology in Housing). PATH is a collaborative effort with the National Science Foundation (Housing & Urban Development, 2008).

The OUP awarded \$400,000 in Doctoral Dissertation Research Grants and Early Doctoral Student Research Grants. The 13 Doctoral Grants distributed were around \$25,000 each and Early Research Grants were around \$15,000 each. Much of the funding in the OUP is focused on minority participation programs. Fourteen million dollars was awarded for Alaska Native, Hawaiian Native, Tribal Colleges and Hispanic –Serving Institutions (Housing & Urban Development, 2008).

The Partnership for Advanced Housing Technology conducts research in seven areas. They are: industry and market research, applied research, barriers analysis, standards and metrics, technology development, PATH technology and university research. In 2005, 10 research projects were funded at nine different universities (Housing & Urban Development, 2008).

Application for HUD grants is through the use of standard government forms found on [www.grants.gov](http://www.grants.gov) and, like NSF, are evaluated based on a standard set of criteria. PATH researchers can qualify to become PATH partners by filling out a simple, one page form. PATH partners agree to participate in field evaluations, site demonstrations, cooperative research, or even conduct research on their own (Housing & Urban Development, 2008).

## *Department of Energy (DOE)*

The Department of Energy traces its history back to the Manhattan Project (1939-1946), the initial effort by the United States to harness the atom. Its overarching mission is to advance the national, economic and energy security of the United States. There are five strategic themes within the DOE. They are energy security, nuclear security, scientific discovery and innovation, environmental responsibility and management excellence (Department of Energy, 2008). Funding for DOE projects is through [www.grants.gov](http://www.grants.gov), similar to the HUD funding application process. Most of the DOE grants are \$100,000 or more.

The Department of Energy has 17 National Laboratories and Technology Centers located throughout the US. Each center has a unique research agenda. Research and development through DOE funding is conducted at the DOE labs or may be funded through a cooperative agreement. One focal point of the Ames, IA research center is technology transfer to small businesses. Cooperative partnerships designed to move research from the university to the private sector are developed with local businesses. The businesses are then used as applied research sites. The Department of Energy has an education program with a stated goal to ensure an adequate supply of scientists, engineers and technicians for energy-related research. DOE is a source for energy related lab equipment for post secondary institutions as well as curriculum materials for K-12 schools (Department of Energy, 2008).

## *Department of Transportation (DOT)*

The United States Department of Transportation (DOT) was opened for business on April 1, 1967. The Research and Innovative Technology Administration (RITA) coordinates the research programs for the DOT and is charged with deployment of “cross-cutting” technologies to improve the US transportation system (Department of Transportation, 2008). RITA funds 10 university transportation centers with \$2 – 3.5 million dollars each. There are also regional transportation centers and tier II centers which are funded between \$500,000 and \$2 million each. Materials research, sustainability and safety are significant functions of the university transportation centers (Department of Transportation, 2008).

The Research Planning and Coordination program coordinates DOT research activities. The program is funded with \$1 billion annually. The mission is to coordinate, facilitate and review DOT’s research and development (Department of Transportation, 2008). In addition to the US DOT, each state has a Department of Transportation with significant funding, especially in materials research.

## **Construction Industry Funding**

### *Associated General Contractors (AGC)*

Current efforts by AGC are focused on improving the construction management process, business education for owners and craft training for field workers. For instance, the Associated General Contractors of America produces an Online Institute (AGC Online Institute, 2008). The Online Institute lists eight courses under the banner of project management, 26 courses under Safety and seven courses under Environmental Programs. AGC offers only one competitive research grant each year in the amount of \$5000.

### *The Construction Industry Institute (CII)*

The Construction Industry Institute (CII), located at the University of Texas at Austin, was formed in 1983 as a result of a study by the Business Roundtable. The mission of CII is to bring research on capital projects under a single national forum. CII lists 57 industrial companies and 65 contractors as members. CII brings owners, contractors and the academic community together for research, chiefly in the industrial sector. To date, CII lists 234 completed projects and 18 active projects on the CII web site (Construction Industry Institute, 2008).

The CII mission is divided into Research, Implementation Support, Benchmarking and Special Functions. Research teams at CII are multifaceted, composed of owners, contractors/suppliers and academics. Owner/contractor members

are responsible for producing results that are usable and beneficial while the principle investigators are from academia, which ensures that the research process meets the required rigor (Construction Industry Institute, 2008).

Research ideas for CII members are generated at fall regional workshops. The Executive Committee and the Research Committee then decide which topics go to a member referendum. The selection process occurs at the July annual meeting. Following the meeting, members are solicited for participation on the research teams. Each project has a unique research team with its own data collection, methodology and reporting goals (CII Today, 2007).

Collaboration with a current CII member is the only realistic method to become involved with the CII academic community (Garcia, 2008). The proposal solicitations are not generally made known to the public, nor is the selection process a public record.

### *National Association of Home Builders (NAHB)*

NAHB has a wholly-owned subsidiary called the NAHB Research Center. A search of the NAHB web site on June 14, 2008, located 521 references for research, including market trends, sustainability, project management and many other topics (National Association of Home Builders, 2008).

NAHB has a philanthropic arm called the National Housing Endowment, whose mission includes student scholarships, student competitions, university assistance with housing programs, labor programs and technology development (National Housing Endowment, 2008). Also included in the work of NAHB is the National Consortium of Housing Research Centers. The center, begun in 1988, is a forum for collaboration of university research and the NAHB Research Center (National Consortium of Housing Research Centers, 2008).

The National Consortium of Housing Research Centers web site provides a listing of annual reports from each of their members. The data from the annual reports were analyzed using a spreadsheet. Each institution was listed and the details of each report were broken down into categories of research. The categories used were National Science Foundation (NSF), Housing and Urban Development (HUD), Other Government, Same University and Other. Due to the inconsistencies in data submitted, it was not possible to analyze the information for funding dollars.

Table 2 lists the results of the data analysis for the members of the National Consortium of Housing Research Centers (NCHRC). The review listed just over 100 projects with published grant amounts ranging from \$1,000 to over \$500,000. The largest grant amount reported was \$1.9 million over four years. There were only a few grants from NSF and HUD, and most reported amounts from the government funding sources were over \$100,000. Slightly over half (51%) of the grants came from Other Government sources. The other sources included school districts, city and county governments and state governments with reported amounts between \$10,000 and \$20,000. Twenty six percent of the research projects were listed in the category of Other. State Farm listed ten projects on their report that were self funded, falling into the Other category. Additional projects in the Other group included a few privately funded projects and two internationally funded projects. Two institutions, Virginia Tech and the University of Florida, as well as the one owner in the group, State Farm Insurance, listed no presentations or publications for their residential groups but had 10 or more funded research projects.

**Table 2**  
*List of Projects for NCHRC members for 2006*

<b>Member</b>	<b>Publications/ Presentations</b>	<b>NSF</b>	<b>HUD</b>	<b>Other Gov't</b>	<b>Private</b>	<b>Same University</b>	<b>Total Research Projects</b>
U of Nevada	7	0	0	2	0	0	2
Virginia Tech	0	2	3	6	0	0	11
Michigan State	3	0	0	3	2	2	7
Georgia	38	0	1	17	3	4	25
Cornell	3	0	2	1	3	1	7
Central FL	7	?	?	?	?	?	?
Ball State	7	0	1	4	1	0	6
U of MN	2	0	3	4	0	0	7
Penn State	90	0	0	4	1	2	7

Texas A&M	41	0	0	1	0	1	2
U of FL	0	0	0	10	0	0	10
Arizona State	7	0	0	0	6	0	6
Purdue	10	0	0	0	0	0	0
State Farm Ins	0	0	0	0	10	0	10
Total # of Projects	250	2	10	52	26	10	100
Percentage of Total Projects		2%	10%	52%	26%	10%	100%

### *National Electrical Contractors Association (NECA)*

ELECTRI International, which is the research arm of NECA, is a foundation whose mission is to coordinate research and education programs for electrical contractors. ELECTRI International has five areas of interest. They are Career Awareness, Productivity Enhancement, Organizational Development, New Business and Technology Transfer. Topics ranged from Integrated materials management to streamlining the home office.

Each year at the beginning of February, ELECTRI sends out notices to the universities asking for ideas and topics for the annual research projects. The application process appears to be simple, with a one page web form to fill out. As of January 2009, there were 30 topics listed as active research. There were an additional ten research projects in final draft. Grant awards appear to be around \$10,000.

## **Conclusions**

The creation of a research agenda for new CM faculty is a long term development process. The broad range of the construction management arena provides a great many choices for faculty research direction, creating a challenge to find a niche in the research funding stream where success is possible.

Identification of a core focus for the individual faculty member is a significant step in creation of a research agenda. The industrial sector of construction is well served by CII, but it is a difficult arena to enter without a the support of a currently participating research program. Sustainability is a hot topic, with NSF and DOE having numerous opportunities. Materials research is one of the least researched topics but one of the cornerstones of the state and national DOT organizations. Housing research is pursued through NAHB and HUD, both of whom will fund sustainability, materials development and business practices.

This review of funding sources resulted in a confidence that a funded research agenda is realistic for new faculty who are transitioning from industry to academia. Successful navigation of the research process will both solidify the body of knowledge for construction management in the future and improve the connection between construction management programs and industry.

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## Appendix A

### *Research Topics from Chinowsky and Diekmann (2004)*

Research Area	Research Topic	% Total Research
Project Development	Risk analysis	8
	Contracts/claims/legal	
	Contractor selection/delivery	
Project planning/design	Constructability	20
	Project organization	
	Planning and workflow	
	Estimating and scheduling	

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Project execution	Project controls Labor and personnel Productivity Methods/equipment Construction engineering Safety	22
Technology	Robotics and automation Information technology Artificial intelligence Distributed computing Computer aided design Multimedia Geographic information systems Quantitative methods/simulation	30
Enterprise forces	Public/private enterprises International Environmental	11
Education research	Education Research plans/interactions	7
Materials		2

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